Notes about Describing Mechanisms

Here's a set of notes about how to describe a mechanism.

Prerequisites

Here's what you need to write an acceptable mechanism description:

- Intimate knowledge
- Access while writing
- Knowledge of terminology
- Definite plan of discussion

Plan for a Specific Mechanism

This plan shows you how to set up a mechanism description using a decimal numbering system.

1.0 Introduction
- 1.1 Definition
- 1.2 Generalized view, (picture, graphic, analogy if useful)
- 1.3 List of main parts

2.0 Description of parts (or features, regions, etc. if the mechanism does not have parts)
- 2.1 Description of part 1
  - 2.1.1 Definition of part 1
  - 2.1.2 General view of part 1 (graphic, picture, drawing)
  - 2.1.3 List of pieces making up part 1
    - 2.1.3.1 Description of first piece of part 1 (size, shape, material, finish, connection, function, etc.)
    - 2.1.3.2 Description of second piece of part 1
- 2.2 Description of parts 2, 3, and so on

3.0 Description of the mechanism in use
- 3.1 Usually chronological and follows the flow of force, momentum, or energy

4.0 Conclusion, if needed

Notes about this plan

- Use present tense to write a mechanism description unless there is a very good reason not to.
- Section 2.0 must describe parts in the same order as the list in section 1.3.
- You won't always need section 4.0. If you decide to include it, you might mention various uses of the mechanism, special features, cost, history, limitations, advantages, etc. You might add a statement of the general purpose or function of the entire mechanism, or of any or all of the parts, if you did not already do so in the Introduction. Or you might include it here in different words.
- Watch out for switches in physical orientation.

Planning a technical description

This plan does not include a numbering system. Instead, it uses size, type style, and layout to convey levels of organization.

Descriptive Title

Introduction

- Include a "hook" or attention-getter that makes the readers want to continue. How will this item help them?
- Define the object.
- Identify the purpose of the object.
- Describe the characteristics of the whole object.
- Identify and name the parts.
- Present a visual that provides an overall view of the object.

Part-by-Part Description

Arrange the part-by-part description in the order of the parts' assembly, location, or importance. Coordinate this section with the list of parts from the introduction.

Part #1 (consider a subheading for the name of the part)

- Define the part.
- Identify the purpose of the part.
- Describe the general appearance of the part.
- Describe the characteristics of the part.
  - ✓ General shape and dimensions
  - ✓ Material and characteristics
  - ✓ Method of manufacture
  - ✓ Surface treatment, texture
  - ✓ Weight
  - ✓ Connection to the next part
- Include a clear and useful graphic, appropriately labeled

Part #2 (same organization as for Part #1), and so on

Conclusion

- Explain how the parts fit together.
- Explain how the parts function together.
- Tie back to the "hook" from the introduction.

Components

- **Structural parts** comprise the physical aspects of the device without regard to purpose. For example, a house key is made of a single piece of metal.

- **Functional parts** perform clearly defined tasks in the operation of the device. Although the key has only one structural part, it has several functional parts, or regions, such as the head (the part you hold while turning), and the toothed section (the part that goes into the lock).

Organizational patterns

A description helps the audience recognize and identify something and enables them to develop a mental picture from the sensory information you provide. Select a logical pattern for describing a mechanism. Some logical patterns include —

Bottom to top
By similar materials
Darkest to lightest
Front to back
Largest to smallest
Most important to least important
Most obvious to most obscure
Outside to inside
Right to left
Strongest to weakest
Tangible to intangible
Widest to narrowest

Diction

The diction (choice of words) for a technical description must be precise so that the information is verifiable. You can achieve this precision in three ways:

- Choose the most specific terms appropriate for your audience.
- Choose technically accurate terms.
- Consider the value of metaphors and similes to convey description.

Visuals

Visuals (graphics) improve most technical descriptions. Remember the saying, "a picture is worth a thousand words."

Blueprints
Cutaway views
Exploded views
Flow diagrams
Overlays
Phantom views
Photographs
Realistic drawings of external features
Schematics and wiring diagrams
Topographic and contour maps

Technical Descriptions

Technical descriptions, mechanism descriptions, device descriptions—different terms for the same kind of writing.

Typical questions to answer in a technical description

- What is it? Provide a functional, sentence definition using a pattern like this:

  A paper punch is a device used for cutting holes in paper so that you can place them in a binder.
  name *class* *words that narrow the class, distinguishing this device from similar devices*

- What is the purpose of the device? Who uses it? For what kinds of tasks? When? Why is it better than other devices for the task?

- What are the characteristics of the whole device or mechanism?
  - ✓ What does it look like? (size, shape, color)
  - ✓ What are its characteristics? (material or substance, weight, texture, flammability, density, durability, expected life, method of production)

- What are its parts? If it does not have parts, what are its regions or features?
  - ✓ What is the appearance of each part, region, or feature?
  - ✓ What are the distinctive characteristics of each part, region, or feature?

- How do the parts fit together?

Audience analysis

- Why do the readers want or need this information? What is their task?
- Are the readers interested in a general overview or a detailed description?
- Do they need information to understand a discussion that is to come later?
- Do they want to make a decision about a purchase?
- What details to the readers need? Dimensions? Materials? Manufacture? Assembly? Function? Capabilities? Costs? Benefits?

Common applications for technical descriptions

Field studies
Manuals
Marketing materials
Observation notes in medicine
Orientation and training materials
Patent applications
Proposals
Public information and education
Reports
Scientific research

Begin reviewing your colleague's work by putting your pencil down. Scan the entire description once quickly, not stopping for details. Then pick up the pencil and begin to read it over in earnest, writing your reactions and comments in the margins, and your specific suggestions for revision in the text. A successful description will provide positive responses for the following questions.

1. Do you understand the general purpose and working of the mechanism? Do you understand the purpose and working of each component?

2. Can you easily imagine who the intended readers are -- their prior knowledge of this device, their mechanical sophistication, their language skills? Are the readers interested just in understanding the mechanism, or will they use it or service it? Are the pace and "density" of the description suited to these readers?

3. Are graphics helpfully located? Are they usefully referred to in the text? Are they accurately titled and numbered, with components labeled as needed?

4. Is the description logically organized by main sections, subsections, and paragraphs? Are there <u>verbal</u> forecasts, interim summaries, and transitions as needed? Does the description <u>visually</u> signal its logical organization by using index numbers or letters, varied headings, and white space?

5. Were you distracted by the grammar, spelling, or punctuation of the description? Did the writer's choice of words or phrasing force you to re-read any sentences, or even to mentally rewrite them?

6. What do you consider was the most difficult aspect of producing this description? How successful was the author in avoiding or overcoming this difficulty?

Damien Pechak
E80-310 (01)
October 5, 2004

Spice Tree® Peppermill

1.0 Introduction

The Spice Tree® peppermill is a handy kitchen device used to grind peppercorns into fresh pepper. It operates like a flourmill and possesses some of the same basic features, as shown in figure 1.1: a bed stone, runner stone, spindle, and exterior casing.

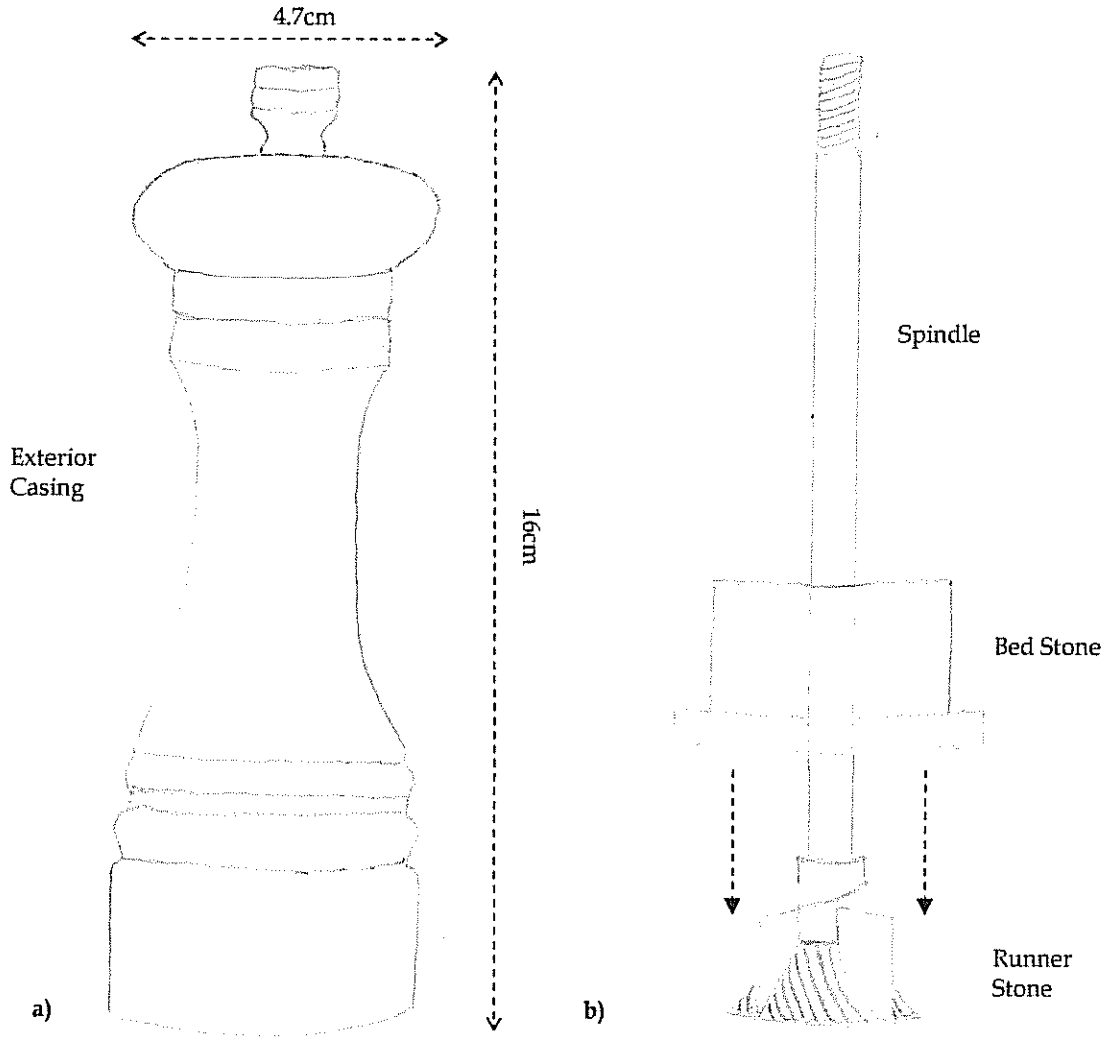

Figure 1: Spice Tree® Peppermill; exterior shown in *a*, and interior shown in *b*
The bed stone in *b* fits over the runner stone.

2.1 Bed Stone and Runner Stone

The bed and runner stones are the core parts of the peppermill, grinding peppercorns between them like their millstone counterparts in the flourmill. However, the peppermill parts are cast from stainless steel and form a basin, unlike the flat quartz surfaces of flourmill stones. The bed stone itself is stationary and acts as a base against which the peppercorns are crushed. It is shaped like an inverted, round tub with a wide rim and has a series of furrows along its inside surface as shown in figure 2.11. The edges of these furrows face counterclockwise. On top of the bed are three radial openings, discussed with the runner in the following section, and one central hole, which the spindle to fits through.

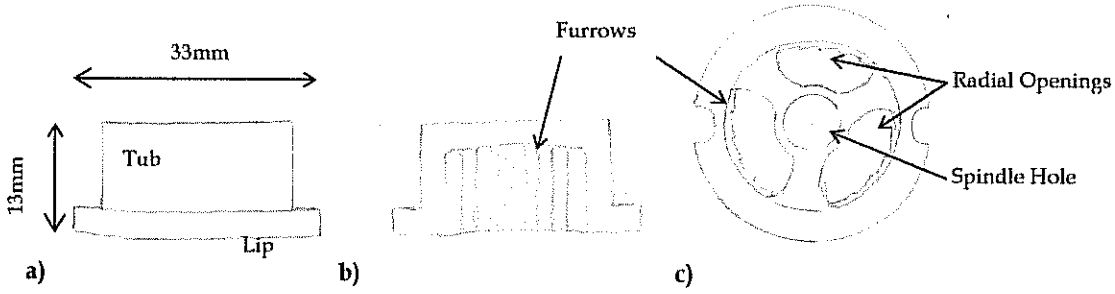

Figure 2.11: Bed Stone. A side view is shown in *a;* a cross section of the side view is shown *c;* and a top-down view is shown in *c.* Notice the edges of the furrows face counterclockwise in c.

The runner stone rotates during operation, guiding the peppercorns into the area between the bed and itself, where the peppercorns are pinned and crushed. Shown in figure 2.12, it has a conical shape out of which four curved spokes rise. In between these spokes are furrows similar to those in the bed, but facing clockwise. The spindle rises out of the center of the runner.

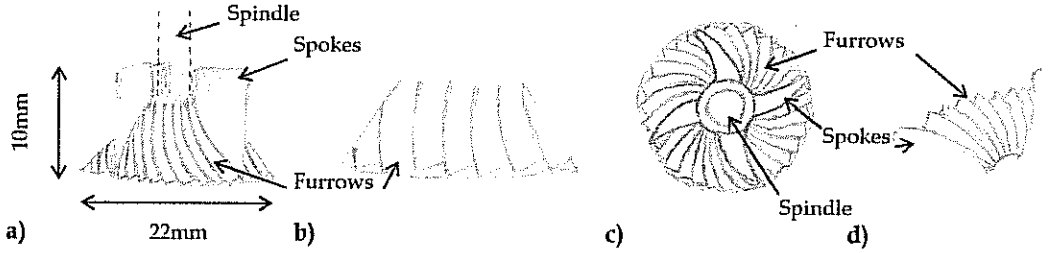

Figure 2.12: Runner Stone. A side view is shown in *a* and a top-down view is shown in *c. b* and *d* show close-ups of the furrows in *a* and *c,* respectively. Notice the edges of the furrows face clockwise on the runner.

When assembled, the runner fits closely inside the bed with less than 1mm gap between the bottom of the runner and the bed as shown in figure 2.13. At the top of the bed, the three radial openings allow peppercorns to fall into this cavity.

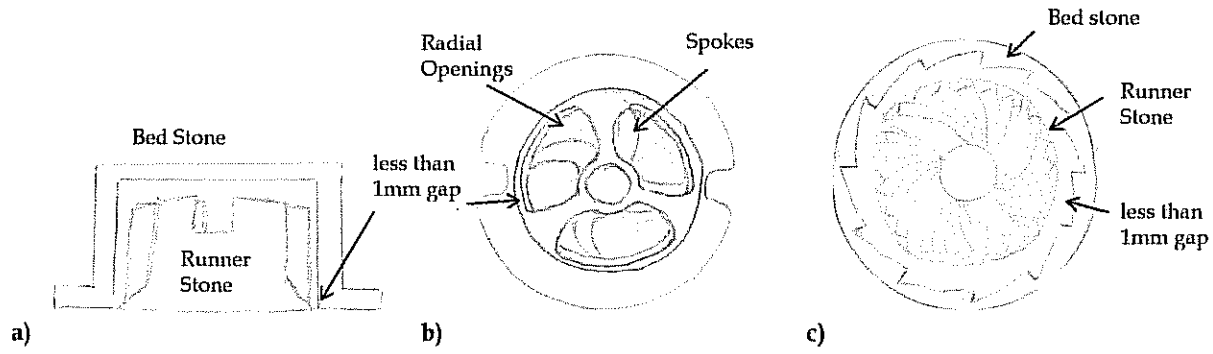

Figure 2.13: Assembled bed and runner stones. A cross sectional side view is shown *a* (for clarity, the furrows and spindle are not shown); top-down view in *b*; and enlarged crosscut of the top-down view in *c*.

Figure 2.14 shows the millstones during operation.

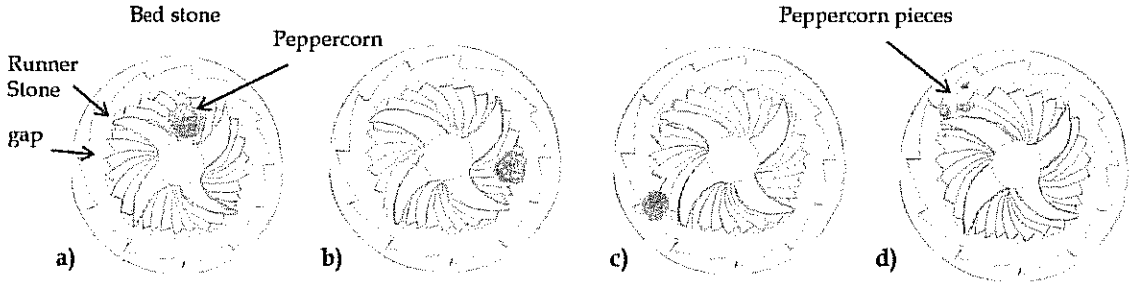

Figure 2.14: Cross sectional top-down view of millstone action; The peppercorn begins at the to of the runner in *a*; as the runner rotates the peppercorn moves down the furrows as shown in *b.*, and is eventually pressed and pinioned between edges as shown in *c* and *d*. Pieces which cannot fit through the gap will be crushed again as the runner rotates.

When the runner rotates clockwise, the peppercorns fall between the curved spokes and along the furrows, to the bottom of the cavity, where they are pressed between the runner and bed. As rotation continues, the peppercorns are pinned by the opposing

furrow edges and crushed into smaller pieces, until they are small enough to fall through the gap at the bottom of the millstone cavity.

2.2 Spindle

The spindle is a long stainless steel shaft which connects the runner stone to the exterior casing and translates exterior rotation to the runner. In the Spice Tree® Peppermill, it is cast as one piece together with the runner, as shown in figure 2.21. The spindle begins as a round shaft, rising out of the runner 10mm, after which it cuts away to a square shaft which runs 155mm up to a final threaded shaft 12mm long. The round section of the spindle fits through the center hole at the top of the bed stone and houses a spring which provides a firm, adjustable interface between the bed and the runner. The square and threaded sections of the spindle fit through the cap in the exterior casing which can rotate the square shaft readily.

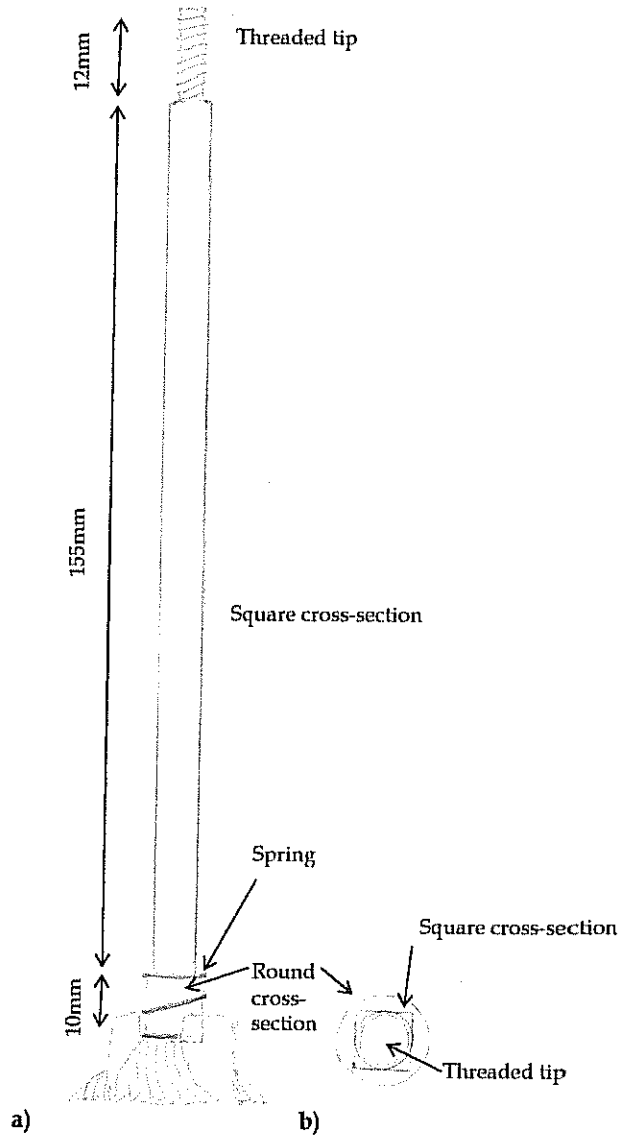

Figure 2.21: Spindle. A side view with the runner is shown in *a*. A top-down view in which the runner is excluded for clarity is shown in b.

2.3 Exterior Casing

The exterior casing houses the spindle, millstones, and peppercorns, providing a foundation for the bed stone, a means to turn to spindle shaft, and a decorative exterior design. It is composed of four pieces, shown in figure 2.31: the body, cap, nut, and bracket.

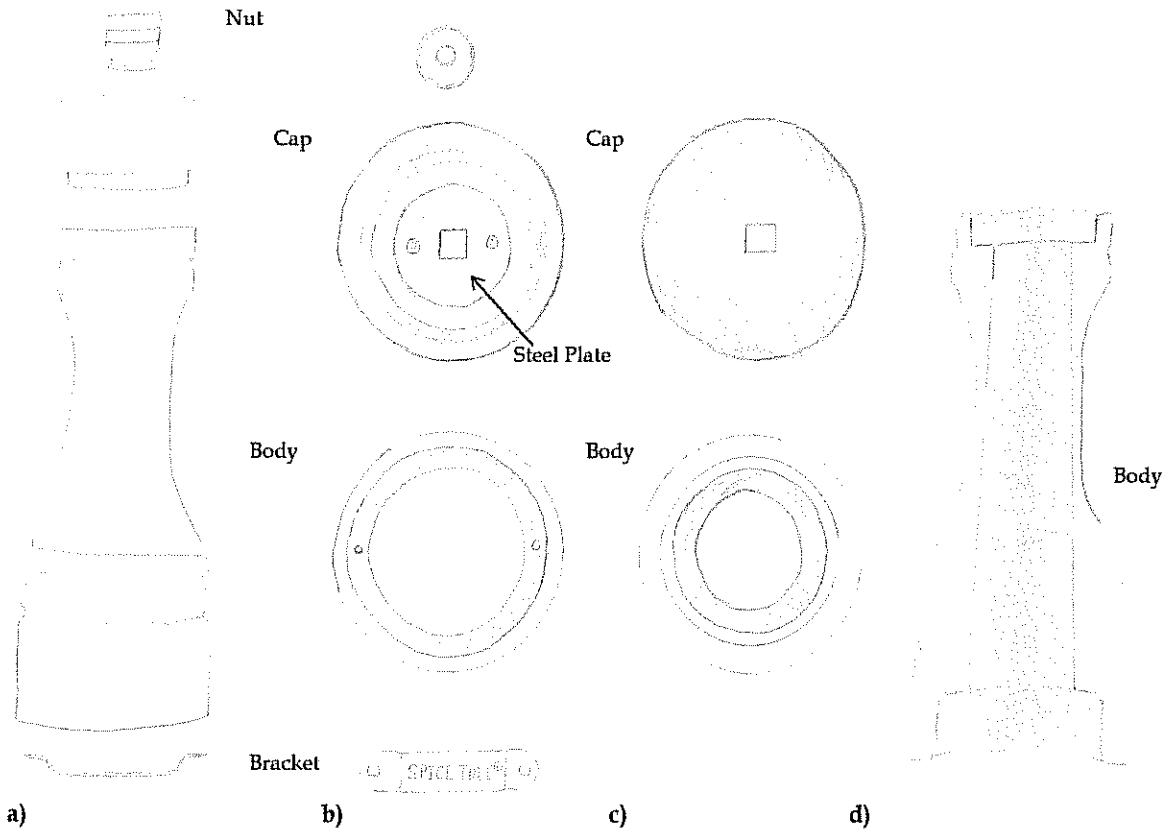

Figure 2.31: Exterior Casing. Side view shown in *a*; bottom-up-view shown in *b*; top-down view shown in figure *c*; and cross-section side view of body shown in figure *d*.

The body and cap, wooden, have a polished exterior finish and a smooth unfinished interior; the nut and bracket are stainless steel. In addition, a round stainless steel plate 1.5mm thick is screwed into the bottom of the cap. The plate has square hole through its center like the cap, and provides the wooden piece a harder surface for turning the metal spindle.

Figure 2.32 shows how all the parts come together. The spindle and millstone assembly fit inside the body with the lip of the bed stone pressing against the recessed bottom of the body. The bracket sits under the bed stone and both pieces are fastened onto the body with two wood screws. The cap fits around the spindle and on top of the body, followed by the nut which screws onto the spindle.

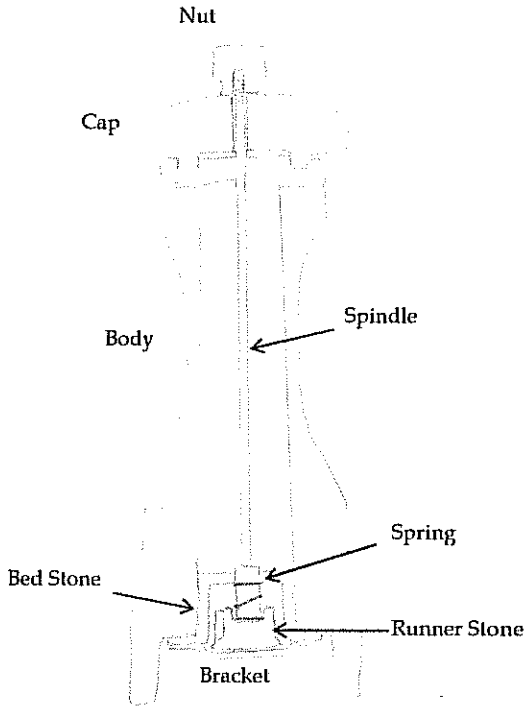

Figure 2.32: Cross-section side view of assembled peppermill.

3.0 Use

To use the peppermill, the nut and cap are removed and peppercorns are poured into the body. The bracket prevents the runner and spindle from falling out during this step. Once the body is filled and the cap back in place, the nut is tightened on, compressing the spring which holds the runner stone in place against the bed stone, and reducing the gap between the bottoms of the two millstones, as shown in figure 3.11. The size of this gap determines the coarseness of the ground pepper; for finer pepper the nut is tightened while for coarser pepper it is loosened.

The coarseness set, the peppermill is now held upright over the food to be peppered and the cap is turned clockwise to grind the peppercorns into pepper flakes which come out the bottom, as shown in

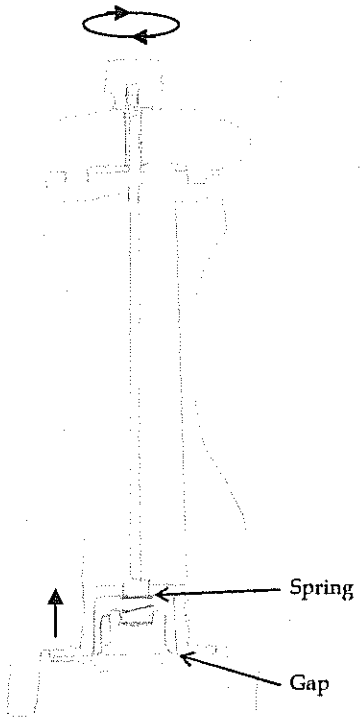

Figure 3.11: Cross-sectional side view of peppermill, with spring compressed and gap reduced (compare with figure 2.32 above). Peppercorns not picture to retain clarity.

figure 3.12. Inside the peppermill, the cap's rotation is translated to the runner through the spindle, and as the runner rotates, the peppercorns fall into and fill up the millstone cavity, where they are ground up as previously described.

Using the Spice Tree® Peppermill is straightforward, but there are two things the user needs to be aware of. First, the peppermill operates most efficiently when the handle is rotated clockwise; if the handle is rotated counterclockwise, the furrows in the bed and runner stone will not catch and crush the peppercorns. However, the peppercorns may still be ground up as they become crammed inside millstones cavity, and are pressed against sides of the bed and rotating runner stones. Therefore there is flexibility in which direction the handle is turned.

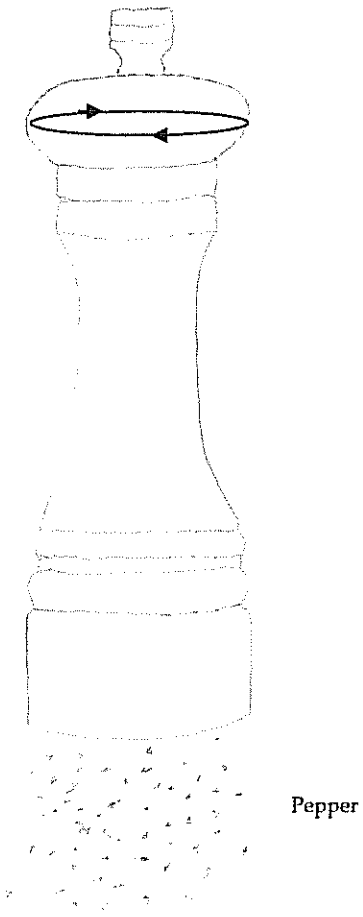

Figure 3.12: To use the peppermill position it over food and rotate handle clockwise. Fresh pepper comes out the bottom.

The user will also notice that, occasionally, rotating the handle will produce no pepper, even though there are peppercorns in the peppermill. Peppercorns can become lodged in the openings at the top of the bed stone, preventing them from entering the millstone cavity. When this occurs, inverting and tapping the peppermill will dislodge the peppercorns. They will resettle inside the cavity after the peppermill is turned upright, and the peppermill will operate normally once more.

The Crescent Wrench

1.0 Introduction

The crescent wrench is a metal tool used for engaging nuts and bolts up to 1 inch in diameter. It has an adjustable jaw that accommodates different shapes and sizes of nuts and bolts, unlike fixed-jaw wrenches. The crescent wrench, with length shown in Figure 1, consists of four parts: a handle, a head, an adjustable jaw, and a thumbscrew assembly.

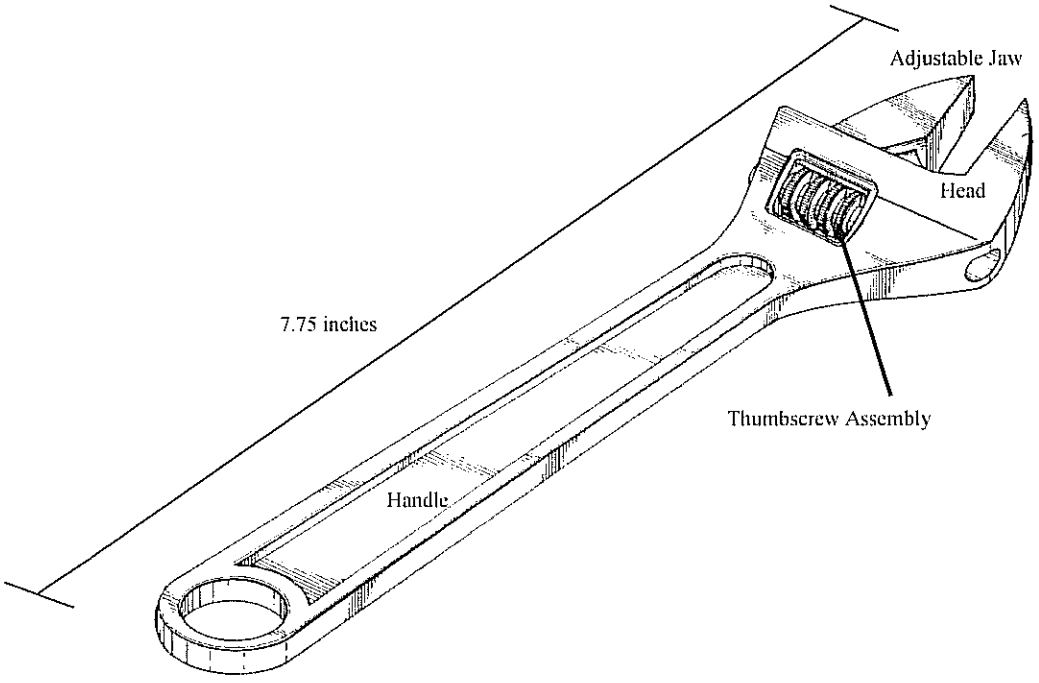

Figure 1: Four parts of a crescent wrench.
(edited from US Patent 6,314,842)

1.1 The Handle

The handle of the crescent wrench is drop-forged from alloy or carbon steel and then plated with a satin-chrome finish. The cross-section, without chrome plating in Figure 2, shows the concave sides of a handle, similar to an I-beam. This design minimizes the weight of the steel handle while optimizing the structural integrity. At the tail of handle, a hole 0.5 in. in diameter can be used for hanging the wrench. Since the perimeter of this hole is 0.2 in. thick, the tail of the handle is 0.9 in. wide. The tail of the handle tapers in towards the 0.75 in. wide neck.

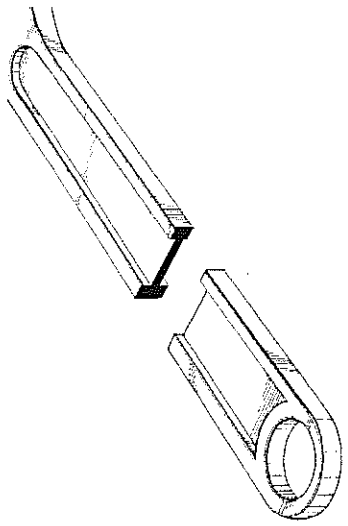

Figure 2: Cross-section of the handle.
(edited from US Patent 6,314,842)

The brand name "GreatNeck" and the words "DROP FORGED" protrudes from the both faces of the handle, not shown in the figures above. The neck of handle widens to the head of the wrench, which contains the engaging mechanism.

1.2 The Head

Figure 3 shows the components of the head of the crescent wrench: a fixed jaw, an adjustable jaw housing, and a thumbscrew assembly housing.

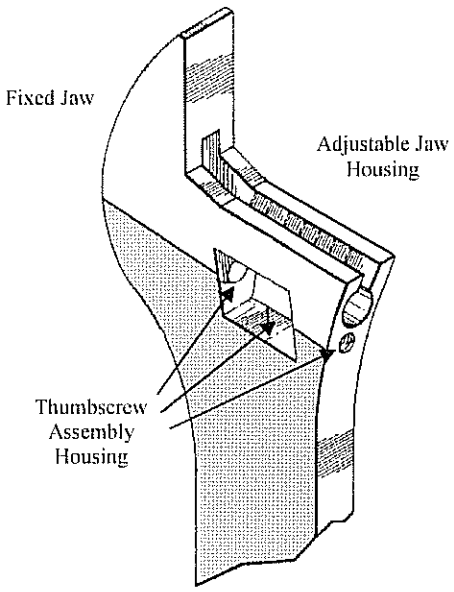

Figure 3: Head of the crescent wrench.
(edited from US Patent 5,540,125)

The entire head is manufactured from the same steel used in the handle of the wrench. However, the satin chrome finish (shaded gray in Figure 3) extends only to the housing of the thumbscrew assembly; the fixed jaw and the housing for the adjustable jaw is polished to a smooth finish.

1.21 The Fixed Jaw

The fixed jaw is continuous with the handle. The profile of the fixed jaw is similar to a dull canine tooth or a crescent. The outer face is curved for safety and the inner face is flat, to engage one side of a nut or bolt. The lower inner face slopes towards the

adjustable jaw housing to create the 120° angle of hexagonal nuts and bolts. Although the top half the fixed jaw is continuous, the bottom half is hollow to house the adjustable jaw.

1.2 The Adjustable Jaw Housing

The adjustable jaw housing is a keyhole-shaped shaft extending 2.25 in. completely through the head of the crescent wrench, as illustrated in Figure 4.

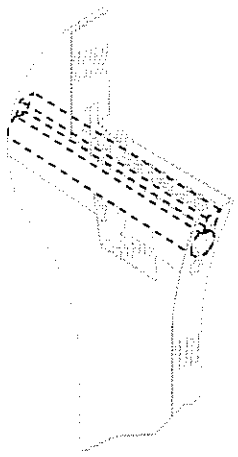

Figure 4: Adjustable jaw housing.
(edited from US Patent 5,540,125)

The cylindrical portion of the keyhole shaft is 0.3 in. in diameter and the top rectangular portion has an open 0.22 in. wide ceiling. This open ceiling extrudes 0.25 in. into the fixed jaw. Both ends of the shaft open to allow protrusion and removal of the adjustable jaw. The middle of the housing, above the neck of the wrench, opens below to the thumbscrew assembly housing.

1.23 The Thumbscrew Assembly Housing

The housing for the thumbscrew assembly, shown in Figure 5, is a cylindrical shaft of 0.22 in. in diameter lying in the same horizontal axis as the adjustable jaw housing. This 1.25 in. long shaft originates opposite and threads into the fixed jaw. A 0.65 in. square pierces completely through the profile of the head in the middle of the shaft, creating a frame for the thumbscrew assembly.

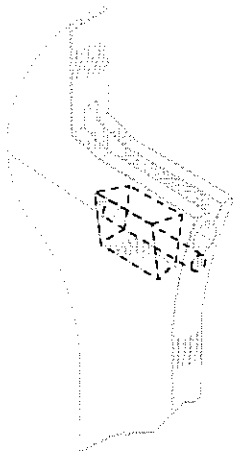

Figure 5: Thumbscrew assembly housing.
(edited from US Patent 5,540,125)

1.3 The Adjustable Jaw

The steel adjustable jaw, independent of the wrench in Figure 6, has a canine-tooth profile similar to the fixed jaw. Similar to the fixed jaw, the adjustable jaw has a curved outer face and a flat inner face. The bottom half of the inner face slopes inward to match the angle of the fixed jaw. The lower middle portion of the inner face attaches to the top point of a 0.2 in. wide triangular base. The triangle extends to the endpoints of a cylindrical base shaft with nine semicircular bottom notches. This base shaft is 1.5 in.

long, 0.25 in. in diameter, and fits the 0.3 in. diameter housing for the adjustable jaw. The jaw is inserted into its housing through the keyhole shaft, opposite the fixed jaw. The adjustable jaw can slide along the length of its housing to adjust to various diameters of nuts and bolts. When engaging the fixed jaw, the base shaft protrudes slightly through the fixed jaw.

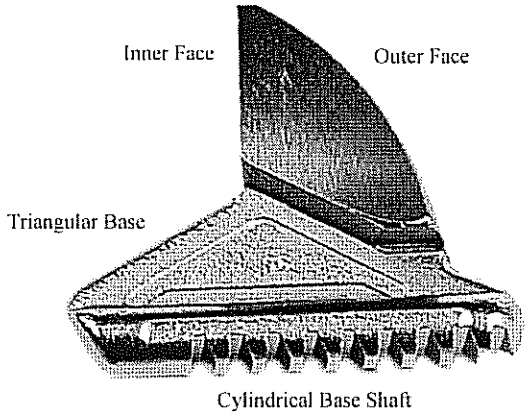

Figure 6: Profile view of the adjustable jaw.

1.4 The Thumbscrew Assembly

Figure 7 shows the three pieces of the thumbscrew assembly: a thumbscrew, a spring, and an axle screw.

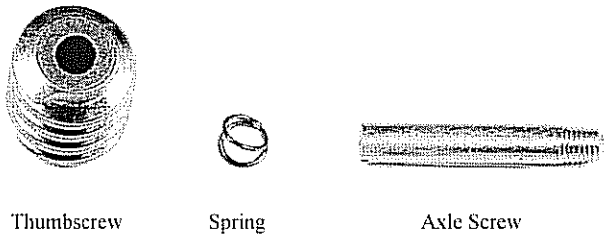

Figure 7: Disassembled thumbscrew assembly.

1.41 The Thumbscrew

The thumbscrew shown in Figure 8 is a spirally threaded wormscrew 0.6 in. long and 0.55 in. in diameter. Between each grooved thread, 0.15 in. deep notches form the base cylinder of the thumbscrew. A cylindrical axle shaft, 0.22 in. in diameter, pierces completely through the base cylinder's axis of rotation. On one end of the thumbscrew, a larger, 0.3 in. diameter shaft extends 0.15 in. into the base cylinder, for housing the spring.

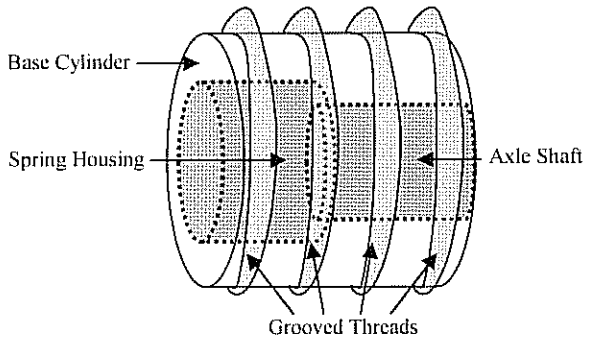

Figure 8: Internal view of the thumbscrew.

Housed in its frame in Figure 9, the thumbscrew translates its lateral rotation into movement of the adjustable jaw, much like a rack-and-pinion system or a worm gear. The threads engage the adjustable jaw notches, moving the jaw along the length of its shaft.

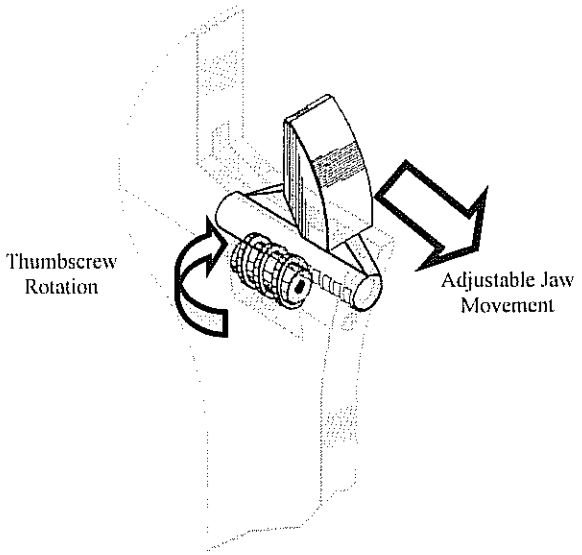

Figure 9: The worm-gear system of the thumbwheel and adjustable jaw.
(edited from US Patent 5,540,125)

1.42 The Spring

The spring housing of the thumbscrew faces towards the fixed jaw and contains a two-thread spring that pushes the worm gear system away from the fixed jaw. The spring force effectively restricts miniscule movements of the thumbscrew, which locks the adjustable jaw.

1.43 The Axle Screw

The axle screw is 1 in. long and 0.21 in. in diameter. Only one end is threaded 0.2 in. long; otherwise, the surface area of the screw is smooth to facilitate thumbscrew rotation. The head of the screw is notched to fit a flat head screwdriver. Sliding through the open assembly housing shaft, thumbscrew axle shaft, and spring, the threaded end screws into the fixed jaw. It can be removed for replacing the adjustable jaw or the thumbscrew assembly.

The fully assembled thumbscrew assembly is shown in Figure 10.

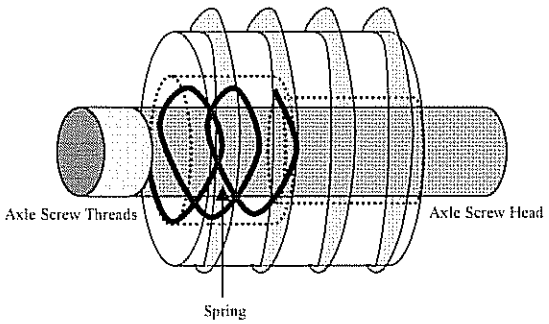

Figure 10: Assembled thumbscrew assembly.

2.0 Using the Wrench to Tighten a Nut or Bolt

To use the crescent wrench for tightening, the target nut or bolt must be less than 1 in. in diameter. Holding the wrench as in Figure 11, the thumbscrew is rotated downwards, to adjust the jaw to its maximum capacity. Place the jaws around the nut or bolt, with the fixed jaw above, and rotate the thumbscrew upwards until the jaws fit. Tighten the nut or bolt by applying clockwise pressure on the fixed-jaw-side of the handle, towards the adjustable-jaw-side.

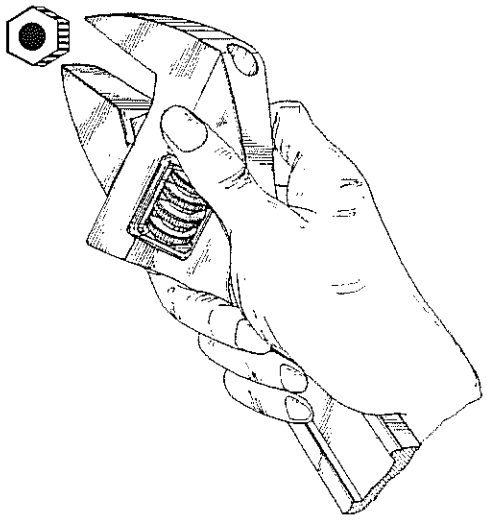

Figure 11: Holding the wrench to tighten a nut or bolt.
(edited from US Patent 6,314,842)

2.1 Using the Wrench to Loosen a Nut or Bolt

To use the crescent wrench for loosening, hold the wrench as in Figure 12. The thumbscrew is rotated upwards to adjust the jaw to its maximum capacity. Place the jaws around the nut or bolt, with the fixed jaw above, and rotate the thumbscrew downwards until the jaws fit. Loosen the nut or bolt by applying counter-clockwise pressure on the fixed-jaw-side of the handle, pulling towards the adjustable-jaw-side.

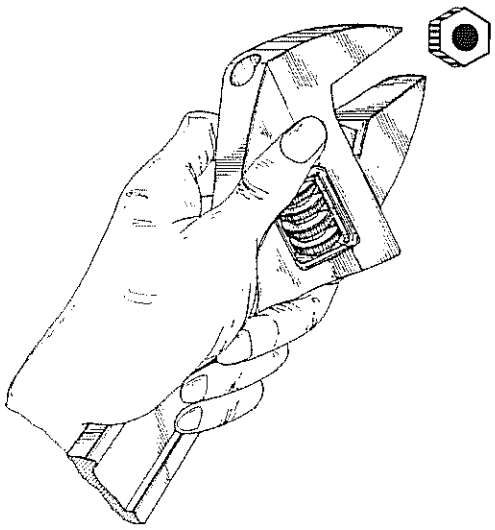

Figure 12: Holding the wrench to loosen a nut or bolt.
(edited from US Patent 6,314,842)

As with other wrenches, pulling is better than pushing; re-orient the wrench so that the applied force is always a pulling force. If the wrench slips away from the nut or bolt, this orientation will cause the head of the wrench to slip away from the user.

Do not attach anything to the handle in an attempt to increase torque. Inserting a screwdriver through the hole in the handle, or extending the handle with a long pipe is unsafe and may cause injury.

Conclusion

The adjustable crescent wrench does the work of several open-jaw wrenches, for a price slightly greater than a single open-jaw wrench. The versatility of the crescent wrench is also a drawback; the adjustable jaw may not lock, causing the wrench to slip and mar the head of the nut or bolt. Since it has moving parts, it has a greater tendency to break. Also, corrosion may impede rotation of the thumbscrew and movement of the adjustable jaw.

ECKO NEE ACTION VEGETABLE PEELER

Introduction

The Ecko Nee Action vegetable peeler, patent number 2,232,940 is a kitchen utensil with a two edged blade which is used for peeling vegetables. While a simple paring knife serves a similar pirpose in food preparation, the Nee Action vegetable peeler has the advantages that the cutting edges face each other for safety and that the blade rotates to follow the contour of the vegetable without the user having to rotate his hand while peeling. The primary components of the device as shown in Figure 1 are the handle, the blade support rod, and the blade.

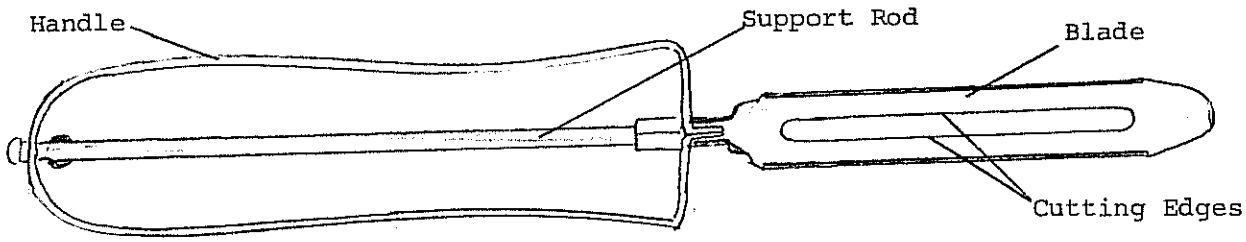

Figure 1 (a). Top View of Vegetable Peeler

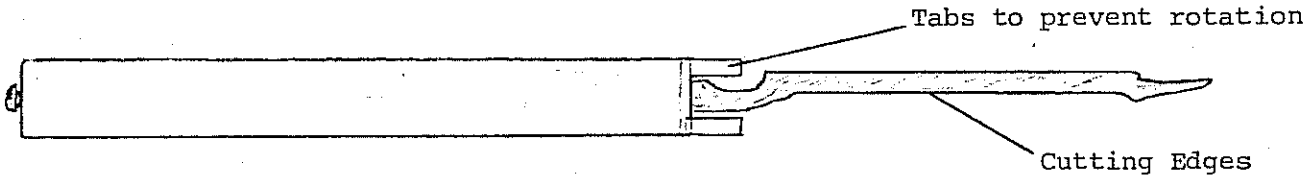

Figure 1 (b). Side View of Vegetable Peeler

Handle

The handle is a light-weight steel frame for transferring forces from the hand of the user to the blade support rod. It is made by bending a 1/16" thick strip of metal as shown in Figure 2 into a contoured loop and spot

Figure 2. Metal Strip for Handle (Not Actual Proportions)

welding the tabs so as to restrict the rotation of the blade. These tabs are visible in Figure 1 (b). A hole is located between the tabs through which the blade shaft passes and a smaller hole is located on the other end of the handle through which the support rod passes. The entire handle is chrome plated for corrosion resistance.

Blade Support Rod

The blade support rod is the means by which all forces are transferred from the handle to the blade and by which axial and lateral translations of the blade are restricted. One end of the 1/8" steel rod passes through the butte of the handle opposite the blade and the other end is connected to the blade. The rod is kept from sliding out of the handle by a mushroom-shaped knob outside of the handle and is kept from sliding too far into the handle by two protrusions inside of the handle.

Blade

The steel blade has a semi-circular cross section with two opposing cutting edges machined into the arc of the curve. Several views of the blade are shown in Figure 3. The blade peels vegetables by sliding either of the

(a) Side View (b) End View (c) View From Handle

Figure 3. Views of the Handle

cutting edges along just under the surface of the vegetable, slicing off a thin layer as it progresses. It rotates to follow the contour of the vegetable. The blade is curved into a complete cylinder on the end which fits inside of the handle. This cylinder encases the end of the support rod and has been mechanically squeezed so as to pinch the rod and hold the two pieces together. The blade quickly becomes sufficiently wide between the tabs on the handle so that it is restricted to 130 degrees of rotation before being stopped by the tabs.

Summary

The Ecko Nee Action vegetable peeler is a handy kitchen utensil for peeling any kind of vegetable and many kinds of fruit. It is unique with regard to a paring knife because of the blade's ability to rotate and thus follow the contour of the vegetable being peeled. The peeler is available almost anywhere at a reasonable cost. The only apparent deficiency in the material or workmanship of the peeler is that the blade is subject to corrosion. For aesthetic reasons a corrosion-resistant alloy would be a better material for the blade.